Digital Multimeter

Model **4800**

INSTRUCTION MANUAL

TRIPLETT
A Penril COMPANY

MP MASTER

MA26128

Digital Multimeter

Model 4800

Instruction manual

We would like to express our appreciation for your purchase of this product. The Model 4800 is a high-reliability measuring instrument making use of the latest in measurement technology. To ensure that you get the most out of your new instrument, we recommend that you read carefully and follow the instructions for use in this manual.

TRIPLETT®
A Penril COMPANY

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1. INTRODUCTION

1—1—1 Overview

The Model 4800 is a multi-function, high-accuracy 4 ½ digit multimeter making use of microcomputer and custom LSI technologies. Its measurement functions include DC/AC voltage, DC/AC current, resistance, frequency, period, dBm, diode test, continuity test and temperature measurement. In addition to these basic functions, the 4800 provides comparator, data hold, peak hold, relative, 3 ½ digit display and autoranging, making it a truly multi-function instrument.

The comparator function is a particularly convenient function which enables a single switch operation to set comparison levels, with low, go and high contact outputs provided. Data is held even with the power switched OFF and the overall design of the 4800 stresses improved ease of operation.

A large 5-digit liquid crystal display with a display range of 0~24999(99999) is used, providing an easy-to-read indication of both measured values and units. Enhancement in ease of operation include autoranging, the use of touch switches and a touch-and-hold probe(option).

1—1—2 Safety Rules

1. Before operating this instrument,familiarize yourself with all

instructions outlined in this manual.

2. Always check to make sure that test lead jacks are fully inserted into input terminals, and that the function/range selector switch is set to the proper position.

3. When taking measurements, use CAUTION as dangerous voltages may be present in normally safe areas.

4. Always disconnect the circuit under test prior to attaching test leads, as voltages may be present in capacitors even when the main power is disconnected.

5. To avoid electrical shock, use CAUTION when working above 60V DC or 25V AC rms. Such voltages pose a shock hazard.

6. Make sure all power(AC or DC) is disconnected(OFF) when making resistance(OHMS) measurements.

1 — 2 Specifications

1—2—1 General Specifications

Product name	Digital Multimeter
Measurement functions	DC voltage, AC voltage, DC current, AC current, resistance, continuity check, diode test, frequency, period, dBm, temperature. comparator, relative, data hold, peak hold, 3 ½ digit display
Measurement method	Dual integration
Display type	5-Digit liquid crystal display Max. display range : (DMM) "24999"

	(FREQ) "99999"
	(REL) "49998"
	Polarity display: Automatic "—" for negative values only.
	Overrange indicator: "OL"
	Low power supply indicator: "BT" appears when the voltage drops below required operating voltage.
Measurement sampling rate	2～4 times/s
Operating environment	0～40℃, 80% RH or less(non-condensing)
Storage environment	−20～60℃,70% RH or less
Temperature coefficient	0～18℃, 28～40℃ : 23℃±5℃ accuracy × 0.1/℃ or better
Calibration interval	One year
Max C/M voltage	±500Vpeak(between COM and ground)
Power supply	100V/117V/200V/230V/240V±10% 50/60Hz
Power consumption	Approx 4W
Dimensions	245(W) ×88(H) × 240(D) mm
Weight	Approx 2kg
Accessories	Instruction manual····· 1
	Input cable ····· 1
	Signal cable(frequency) ····· 1
	Alligator clips(red and black, 1 set)
	Spare fuses(two 1A/250V)

1—2—2 Electrical Specifications(23℃ ±5℃, 80% RH or less)

Accuracy specified; ±(% of reading + number of digits)

DC Voltage Measurement

Range	Resolution	Accuracy	Input impedance
250mV	10μV	±0.04%±2LSD	>1000MΩ
2500mV	0.1mV		11MΩ
25V	1mV		10MΩ
250V	10mV		
1000V	0.1V		

Response time·····1s or less(manual ranging in the same range)

Overload protection·····DC1200V, AC900Vrms

(250mV range only : DC 500V or AC 500Vrms)

NMRR·····60dB or better, 50/60Hz

CMRR·····100dB or better, 50/60Hz, Rs=1kΩ

AC Voltage Measurement(true rms value)

(Applies for values of 8% or greater with respect to fullscale value and 100V or greater in the 750V range.)

Range	Resolution	Frequency			Input impedance
		20Hz~10kHz	10kHz~50kHz	50kHz~100kHz	
250mV	10μV	±0.5%rdg ±10LSD	±1%rdg ±40LSD	±3%rdg ±200LSD	>1000MΩ// <100pF
2500mV	0.1mV				11MΩ// <100pF
25V	1mV				10MΩ// <50pF
250V	10mV				
750V	0.1V	±0.8%rdg ±10LSD	20Hz ~ 1kHz		

Response time·····3s or less(manual ranging in the same range)

Overload protection·····DC1200V, AC900Vrms(250mV range only: DC 500V, AC 500Vrms)

Acceptable crest factor of AC input·····< 3

DC Current Measurement

Range	Resolution	Accuracy	Maximum voltage drop
250μA	10nA	±0.3%rdg±2LSD	0.3V or less
2500μA	100nA		
25mA	1μA		
250mA	10μA		0.5V or less
1000mA	100μA		0.7V or less
10A	1mA	±1%rdg±2LSD	0.2V or less

Response time·····1s or less(manual ranging in the same range)

Overcurrent protection·····250μA~1000mA ranges: 1A/250V fuse and 4A/600V fuse(dual protection)

10A Range: No fuse protection

AC Current Measurement(true rms value)

(Applies for values 8% or greater with respect to fullscale)

Range	Resolution	Frequency range	Accuracy	Maximum voltage drop
250μA	10nA	20Hz~5kHz	±0.75%rdg ±10LSD	0.3Vrms or less
2500μA	100nA			
25mA	1μA			
250mA	10μA			0.5Vrms or less
1000mA	100μA	20Hz~1kHz		0.7Vrms or less
10A	1mA		±2%rdg ±10LSD	0.2Vrms or less

Response time·····3s or less(manual ranging in the same range)

Overcurrent protection·····250μA~1000mA ranges: 1A/250V fuse and 4A/600V fuse(dual protection)

10A Range: No fuse protection

Acceptable crest factor of AC input·····< 3

Resistance Measurement

Range	Resolution	Accuracy	Maximum measurement current	Open-circuit voltage
250Ω	10mΩ	±0.06%rdg ±2LSD ±0.1Ω	1.5mA	Approx 5v
2500Ω	100mΩ	±0.06%rdg ±2LSD	1.2mA	
25kΩ	1Ω		200μA	Approx 2V
250kΩ	10Ω		20μA	
2500kΩ	100Ω	±0.25%rdg ±2LSD	2μA	
25MΩ	1kΩ	±0.75%rdg ±3LSD	200nA	

Response time·····250Ω~250kΩ ranges : 3s or less(manual ranging in the same range)

2500kΩ range : 5s or less(manual ranging in the same range)

25MΩ range : 8s or less(manual ranging in the same range)

Overload protection····· DC : 400V, AC : 400Vrms

Continuity Check

Range	Resolution	Trip point of continuity buzzer	Maximum measurement current	Open-circuit voltage
250Ω	10mΩ	Less than approx 20Ω±10Ω	1.5mA or less	Approx 5V

Operational check·····An electronic beeper sounds and the "Go" annunciator appear on the LCD for resistances less than 20Ω.

Overload protection·····DC : 400V, AC : 400Vrms.

Frequency Measurement(Autoranging)

CH-A Frequency(synchronized frequency conversion method)

Frequency range(autoranging)	Resolution	Accuracy
10.000Hz~99.999Hz	0.001Hz	±0.05%rdg
90.00Hz~999.99Hz	0.01Hz	
0.9000kHz~9.9999kHz	0.1Hz	
9.000kHz~99.999kHz	1Hz	

Period

Frequency range(autoranging)	Resolution	Accuracy
99.999~9.000ms	1μs	±0.02%rdg ±1LSD
9999.9~900.0μs	100ns	
999.99~90.00μs	10ns	
99.999~9.000μs	1ns	

Coupling·····DC

Maximum input sensitivity·····250mV range : 10Hz~100kHz, 150mVrms

Input attenuator·····Manual setting(AC voltage range)

AC voltage range	Muximum input voltage	Input impedance
250mV(1/1)	±5VPeak	>1000MΩ // <100pF
2500mV(1/10)	±50VPeak	11MΩ // <50pF
25V(1/100)	±500VPeak	10MΩ // <50pF
250V(1/1000)	±1000VPeak	
750V(1/10000)		

CH-B Frequency

Frequency range(autoranging)	Resolution	Accuracy
10.000kHz~999.99kHz	0.01kHz	±0.02%rdg
900.0kHz~9999.9kHz	0.1kHz	±1LSD

Coupling·····AC

Maximum input sensitivity···· 10kHz~5MHz : 50mVrms~10Vrms

5MHz~10MHz : 100mVrms~3Vrms

Input impedance·····>100kΩ//<100pF

Maximum allowable applied voltage·····DC50V, AC50Vrms

Diode Test

Measurement range·····0~2499.9mV

Resolution·····0.1mV

Accuracy·····±0.1% rdg ±2LSD

Measurement current·····Approx 1mA

Open-circuit voltage·····Approx 5V

Overload protection·····DC400V, AC400Vrms

Note : The display indicates the forward voltage drop of the diode under test.

Logarithmic AC Voltage Measurement(Autoranging)

<table>
<tr><th>Frequency / Input voltage</th><th>20Hz～
1kHz</th><th>1kHz～
10kHz</th><th>10kHz～
30kHz</th><th>30kHz～
100kHz</th></tr>
<tr><td>−50.00dBm～
−35.84dBm
(2.45～12.50mV)</td><td>±0.5dB</td><td>±1dB</td><td colspan="2">Not Specified</td></tr>
<tr><td>−35.84dBm～
−29.82dBm
(12.50～25.00mV)</td><td colspan="2" rowspan="2">±0.15dB</td><td rowspan="2">±0.5dB</td><td></td></tr>
<tr><td>−29.82dBm～
48.66dBm
(25.00mV～210.00V)</td><td>±1.2dB</td></tr>
<tr><td>48.66dBm～
59.72dBm
(210.00～750.0V)</td><td>±0.15dB</td><td colspan="3"></td></tr>
</table>

Input impedance……Same as for AC voltage measurement

Overload protection……Same as for AC voltage measurement

Temperature Measurement

probe used : K (Chromel/Alumel) type sensor

Display units	℃	℉
Measurement range	−50℃～1200℃	−58℉～2192℉
Resolution	1℃	1℉
Accuracy (4800 only)	±0.5%rdg±3LSD	±0.5%rdg±5LSD

Data Hold

Applicable functions·····DC voltage, AC voltage, DC current, AC current, resistance, dBm, diode test, relative, temperature

Peak Hold (Manual Ranging)

Applicable functions·····DC voltage, AC voltage, DC current, AC current, temperature

Accuracy·····(Range accuracy) ±(2% rdg + 100LSD)
Temperature only : ±1LSD

Response time·····DC voltage/current(less than 5ms)
AC voltage/current(less than 250ms)
(Time required to reach specified accuracy)

Measurement method·····For voltage and current measurement, an analog circuit is used for detection and a digital circuit is used to hold the data value. For temperature measurement, a direct digital circuit reads in values.
For DC voltage and current, measurement is possible only for positive polarities.

REL(Relative)

Applicable functions·····DC voltage, AC voltage, DC current, AC current, resistance(manual range only for all functions)

3 ½ Digit Display

This mode blanks the least significant digit for all functions.

Comparator(Manual Ranging)

Applicable functions·····DC voltage, AC voltage, DC current, AC current, diode test

Measurement method·····The results of a digital comparison are displayed, a beeper is sounded and a contact output is made available for external use. If the measured value is within the high and low values set using the touch switches, "Go" appears in the LCD and the beeper sounds. If the value is above the set value, "Hi" appears and if the value is below the set value, "Lo" appears. Note that this comparison is not made in the overload(OL) condition.

Key Lock

By depressing this switch, all switches with the exception of the power switch are disabled.

Rear Panel Outputs(EXT)

The following three types of external output signals are available at the rear panel.

- Comparator Relay Contact Output

  Maximum voltage·····DC50V, AC50Vrms

  Maximum current·····DC100mA, AC100mArms

- External Power Supply Output

  Output voltage(DC)·····Approx +12V

  Maximum load current·····50mA

● Analog Output(AC Voltage/Current)

Output voltage·····0～250.00mV ±(1% rdg + 0.5mV)

Load resistance·····10kΩ or greater

2. OPERATION

2 — 1 Preparations and Precautions Before Use

(1) Before using, connect the power cable.

(2) Avoid using the 4800 in locations subject to high temperatures, high humidity or excessive vibration.

(3) Avoid using the 4800 in locations subject to sudden changes in temperature.

(4) Use in close proximity to equipment which produces noise can cause an unstable display or excessive display error.

(5) To avoid damage to the Model 4800:

Always observe the limitations on maximum allowable applied voltage. In particular, be careful with the 10A range, since a protective fuse is not provided. When making measurements in this range, use a 20A fuse or circuit breaker externally to provide protection.

(6) When high-accuracy measurements are to be performed, allow a 10 minute warmup period before use.

(7) If the function must be switched during a measurement, always remove the input cable from the circuit being measured.

2 — 2 Panel Descriptions

Fig. 2—1, 2—3 show the Model 4800's front panel and display. Front

and rear panel and display descriptions are contained in the tables that follow.

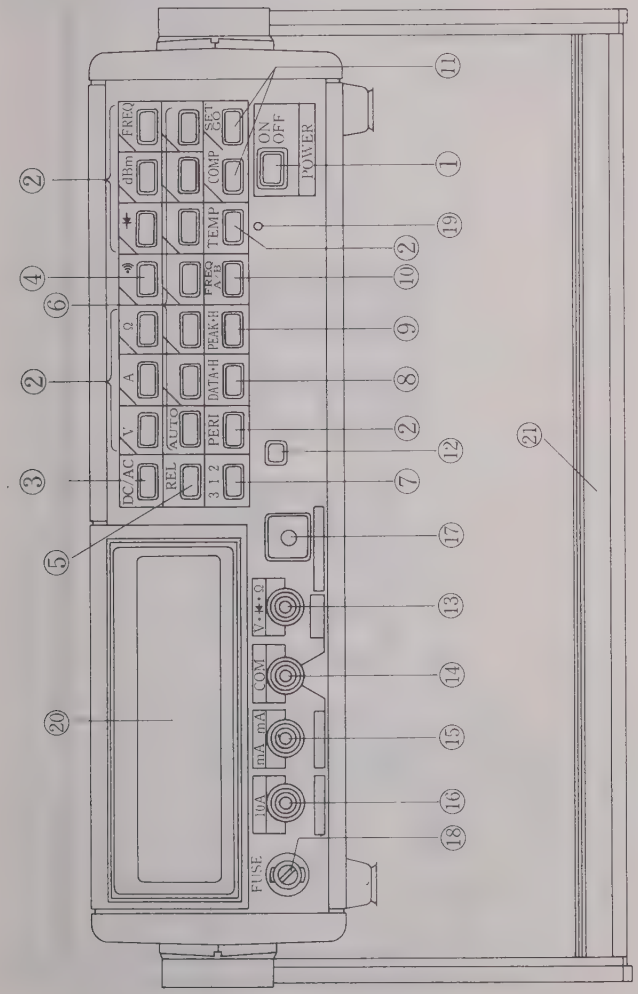


Fig. 2—1 Front panel layout

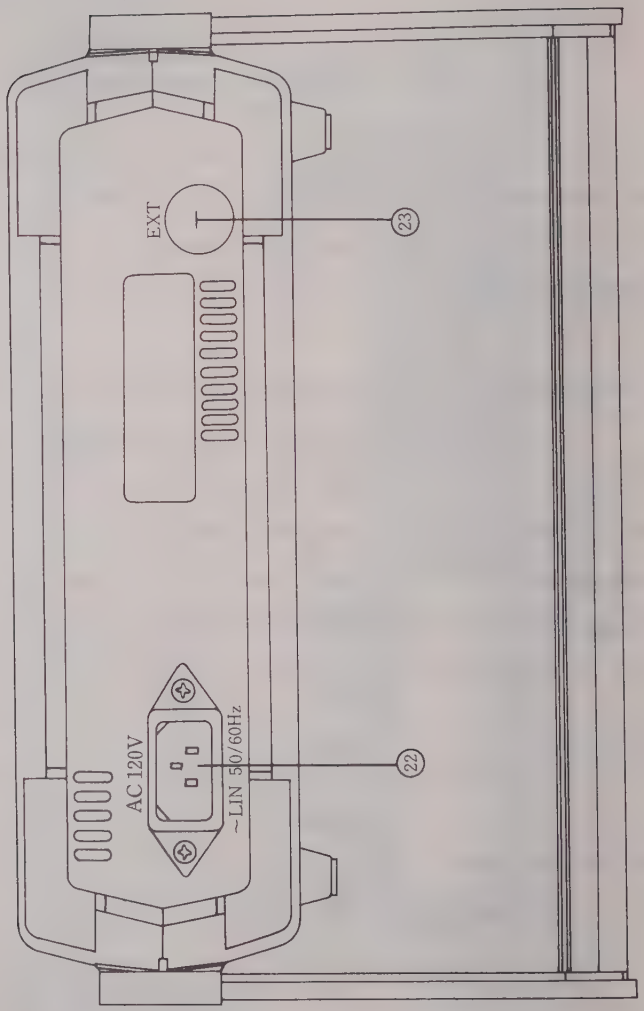
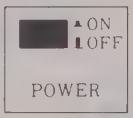
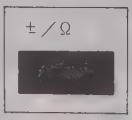
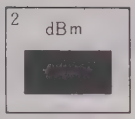
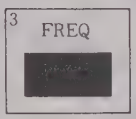
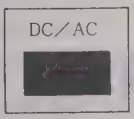
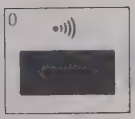
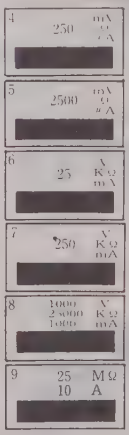
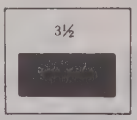


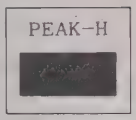
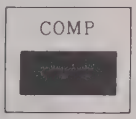
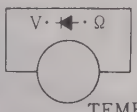
Fig. 2—2 Rear panel layout

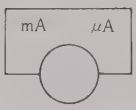
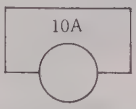
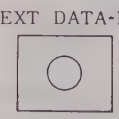
Fig. 2—3 Display

No.	Name	Panel	Function
1	Power switch		When this pushbutton switch is depressed, it locks into the depressed condition and power is applied. Press it once again to release the lock and remove power.
2	Main function switch		This switch is pressed to measure voltage. It also serves to select the "high" and "low" comparison limits setting modes for comparator operation.
			This switch is pressed to measure current. It also serves to switch the limit value between display value and percentage for comparator operation.
			This key is pressed to measure resistance. It also serves to switch the limit setting polarity for comparator operation.
			This switch is pressed to perform diode testing. It also serves to set the limit setting value to "1" for comparator operation.

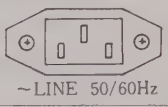
			This switch is pressed to make dBm measurements. It also serves the set the limit setting value to "2" for comparator operation.
			This switch is pressed for frequency measurements. It also serves to set the limit setting value to "3" for comparator operation.
			This switch is pressed to make period measurements.
			This switch is pressed to make temperature measurements. Pressing it once sets centigrade(℃) and pressing it once again sets Fahrenheit(℉).
3	DC/AC Switch		This switch is pressed to measure AC voltage or current when in the voltage/current measurement mode.
4	Continuity check switch		When this switch is pressed in the resistance measurement mode, the continuity check function is enabled. It also serves to set the limit setting value to "0" for comparator operation.

5	Relative reference(offset) switch		When this switch is pressed, the REL(relative) mode is enabled for manual ranging.
6	Range switches		This switch is pressed to enable autoranging for voltage, current or resistance measurements.
			These switches are used in the voltage(frequency), current and resistance modes to manually select the 250mV ~1000V, 250μA~1000mA ~10A and 250Ω~25MΩ ranges, respectively. These switches also serve to set the limit setting value to "4~9" for comparator operation.
7	3½ digit display switch		This switch is used to blank the least significant digit of the display, for any function except temperature measurement.
8	Data hold switch		This switch is used to hold the display for all functions except frequency, period, continuity check and peak hold.

9	Peak hold switch		This switch is used to enable the peak hold function for voltage, current and temperature functions when manual ranging is used.
10	Frequency measurement channel switch		This switch is used to select either channel A or channel B for frequency function measurements.
11	Comparator switches	 	These switches are used for comparator operation in the voltage, current, diode test and resistance measurement modes. When the COMP switch is pressed, the comparator is enabled and, in this mode, when the SET/GO switch is pressed, the comparator high and low comparison values are set.
12	Key lock switch		This switch may be depressed to lock all touch switches except the power switch.
13	V, ⊣⊢, Ω, FREQ-A, TEMP Input terminal		This is the input terminal for voltage, resistance, diode test, frequency-A, period, dBm, temperature and continuity check functions.

14	COM Input terminal		This serves as the common input terminal for all measurements.
15	μA/mA Input terminal		This terminal serves as the current measurement terminal for currents under 1A.
16	10A Input terminal		This terminal serves as the current measurement terminal for currents under 10A.
17	External data hold terminal Frequency channel B input terminal		This terminal is used when an external display hold is performed by such a device as a touch-and-hold prob(option). It also serves as the channel B frequency measurement input terminal.
18	Current measurement circuit protective fuse (not used for 10A range)		This terminal serves as the overcurrent protection fuse for μA/mA input(i. e., for currents up to 1A).
19	Reset switch		During use, it may happen that noise or other causes result in an abnormal display(this is quite rate). If this occurs, use

			a ball point pen or other sharp pointed object to press this switch. All data will be cleared. Before doing this, the key lock switch should be cancelled.
20	Display	See Fig. 2 — 3	This is a 5-digit liquid crystal display. The numerical display range is 0～9999 and the display includes a decimal point, overload input "OL", autorange "AUTO", manual range "MANU", comparator "COMP", "SET", "LO", "HI" and "GO", polarity "—", "REL", "PEAK H", "DATA H", function displays "DC", "AC", "•))", "⊣⊢", "FREQ" and "PERI" and unit displays "dBm", "℃", "℉", "mV", "V", "μA", "mA", "A", "μs", "ms", "%", "Ω", "kΩ", "MΩ", "Hz", "kHz" and "MHz". When the power supply voltage drops to below the required operating voltage, the "BT" indicator appears to signal this condition.

21	Handle		This handle is used in carrying the 4800 and may also be used as a stand.
22	AC Connector		This connector mates with the accessory power plug cable.
23	External output connector		The comparator LO, GO and HI high contact outputs are available at this connector, which mates with the accessory DIN plug.

Notes on Symbols

⚠ Caution symbol : Indicates the operator should refer to an explanation in this manual to prevent damage to the 4800.

Danger Signal

This symbol appears when a dangerous voltage is applied to the input terminals. Care should be taken when making high-voltage measurements to prevent shocks.

2 — 3 Input Limitations

The input limitations for each of the measurement functions are as described below. Always maintain input within these limitations.

Function	Input terminals	Maximum input voltage/ current
DC voltage AC Voltage dBm Frequency(CH-A) (Ranges above 2500mV)	Between V • Ω • ⊣◀• FREQ/Temperature input terminal and COM input terminal	DC 1200V AC 900Vrms
Same as above (250mV range)		DC 500V AC 500Vrms
Resistance Diode test Continuity check Temperature		DC 400V AC 400Vrms
DC Current AC Current (mA/μA range)	Between input terminal and COM input terminal	DC 1A AC 1Arms
DC Current AC Current (10A range)	Between 10A input terminal and COM input terminal	DC 10A AC 10Arms
Frequency(CH-B)	FREQ-B	DC 50V AC 50Vrms

2 — 4 Measurement Method

Set the POWER switch to ON. When the Model 4800 is first powered on, a beeper is sounded.

Caution

If, with the power switched ON, the display appears abnormal or the beeper does not stop, verify that the KEY LOCK switch has not been set and press the RESET switch as described in Section 2—2.

2—4—1 DC and AC Voltage Measurement

(1) Connect the input cable to the input terminals. The red plug should be connected to the V terminal, and the black plug to the COM terminal.

(2) Select the V function switch.

(3) Press the AC function switch, depending upon whether the signal being measured is DC or AC. This switch operates in toggle fashion so that pressing it once selects AC and pressing it once again returns the instrument to the DC measurement mode. In the AC measurement mode, "AC" will appear on the display.

(4) Set the range switch group to a range appropriate to the voltage to be measured. To enable the autoranging function, press the AUTO switch.

To cancel the autoranging function, press any measurement manual range selection switch.

In the autoranging mode, "AUTO" appears on the display.

(5) Connect the input cable to the circuit to be measured.

2—4—2 DC and AC Current Measurements

(1) Connect the input cable to the input terminals. Connect the red plug to the mA, μA terminal and the black plug to the COM terminal.

For measurements in the 10A range, make connections to the 10A and COM input terminals. Note that in this range, the accessory input cable may not be used. Use a separate cable with sufficient current carrying capacity(option).

(2) Press the A function switch.

(3) Press the AC function switch to switch between DC and AC as was described for voltage measurements.

(4) Select a range switch appropriate to the current to be measured.

(5) Connect the input cable to the circuit to be measured.

2—4—3 Resistance Measurement

(1) Connect the input cable to the input terminals. Connect the red plug to the Ω terminal and the black plug to the COM terminal.

(2) Press the Ω function switch.

(3) Select a range switch appropriate to the resistance to be measured. To enable autoranging, press the AUTO switch.

(4) Connect the input cable across the resistance to be measured. In the resistance mode(manual ranging), it is necessary to first short input the cable and press the REL switch to zero the resistance function and ensure maximum measurement accuracy. This is to compensate for the resistance of the input cable itself. Note that the

REL switch is not operative in the autorange mode.

2—4—4 Continuity Check

(1) Connect the input cable to the input terminals. Connect the red plug to the Ω terminal and the black plug to the COM terminal.

(2) Set the Ω function switch and press the •)) switch, at which point the continuity check function will be enabled and the "•))" mark will appear on the display. If the •)) switch is pressed once more or if any other function switch(with the exception of Ω) is pressed, this function is disabled.

(3) Connect the input cable to the circuit to be measured. The continuity beeper will sound when the resistance of the circuit under measurement is below approximately 20Ω. Simultaneous with the beeper, the "Go" mark at the upper right of the LCD will appear as well. Since the display indicates that the instrument is in the 250Ω resistance measurement range, measured values of resistance in the range 0~249.99Ω will also be displayed.

2—4—5 Diode Test

(1) Connect the input cable to the input terminals. Connect the red plug to the ⊣◀ terminal and the black plug to the COM terminal.

(2) Press the ⊣◀ function switch.

(3) Connect the input cable in the forward direction as shown in Fig. 2—4(a). The display will indicate the forward voltage VF across the diode. For the usual diode, this should be indicated in the range 500 ~700mV. If the diode is effective or shorted, a value close to 0mV will be displayed and, if the diode is open, the "OL" mark will

appear. Next, make connection in the reverse direction, as shown in Fig. 2—4(b). If the diode is normal, the "OL" mark will appear, just as for the open condition. However, if the diode is defective, the indication will be approximately 0mV, the same as for a shorted diode.

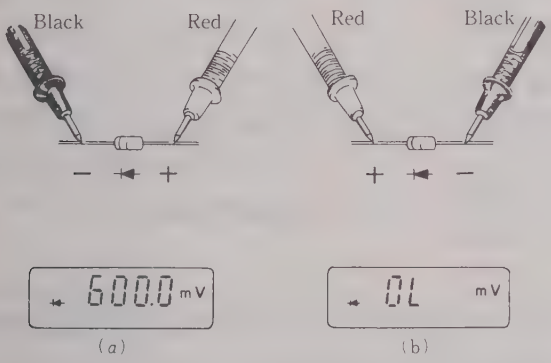


Fig.2—4

2—4—6 Frequency Measurement

To measure frequency, two channels, CH-A and CH-B are provided. The frequency measurement range and resolution of these channels differ, and require selection as described in the table below.

Channel	Frequency range	Input impedance
CH-A	10.000Hz~99.999kHz	Approx 10MΩ// <50pF
CH-B	10.00kHz~9999.9kHz	Approx 100kΩ// <100pF (including signal cable)

CH-A(Calculation of Frequency from Measured Period)

Autoranging is used for frequency measurement. The input attenuator is set by means of the AC voltage range manual settings as shown below.

AC Voltage range	Maximum input voltage
250mV(1/1)	±5VPeak
2500mV(1/10)	±50VPeak
25V(1/100)	±500VPeak
250V(1/1000)	±1000VPeak
750V(1/10000)	

(1) Connect the input cables to the input terminals. Connect the red plug to the FREQ-A terminal and the black plug to the COM terminal.

(2) Press the FREQ function switch.

(3) Connect the input cable to the circuit to be measured.

Caution

In making CH-A frequency measurements, the period is measured and the frequency is calculated from this value so that to the period measurement resolution, the frequency display does not change continuously. To make continuous measurements, period measurement should be used.

CH-B(Frequency Counting Method)

(1) Connect the accessory signal cable(with miniature plugs) to the FREQ-B input terminal.

(2) Press the FREQ function switch and the FREQ A/B switch. When this is done, the display will read "0.00kHz".

(3) Connect the signal cable to the circuit to be measured.

2—4—7 Period Measurement(CH-A)

The frequency of CH-A is displayed by means of this period measurement.

Channel A frequency $= \frac{1}{T}$

(1) Connect the input cable to the input terminals. connect the red plug to the FREQ-A terminal and the black plug to the COM terminal.

(2) Press the PERI function switch.

(3) Connect the input cable to the circuit to be measured.

2—4—8 Measurement of Temperature

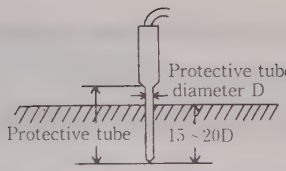
(1) Connect the K-type thermocouple probe to the input terminals. Connect the red test lead to the "TEMP" terminals and the other(black) test lead to the "COM" terminal.

(2) Set the function switch to TEMP. Pressing the TEMP switch once selects ℃ display and pressing it once again changes the display units to ℉.

(3) Perform measurements by contacting the object being measured with the probe sensor.

Cautions

- To measure the internal temperature of an object, insert the protective tube to a depth of 15~20 times the diameter D.



- When moving the 4800 to a location which would subject it to a temperature difference or when connecting the probe plug to the 4800's jack, allow 30 minutes or more before measurements are made to allow the input jack reference junction compensation to stabilize.
- The temperature measurement probe molded section and lead wires(compensating wires) can withstand 100℃/212℉ and 80℃/176℉, respectively. Care should be taken that these parts are not subjected to higher temperatures than stated.

2—4—9 Decibel(dBm)

In this mode, 0dBm corresponds to a voltage(0.7746Vrms) which causes a 1mW dissipation into 600Ω.

(1) Connect the red test lead to the "V" terminal and the other(black) test lead to the "COM" terminal.

(2) Set the function switch to "dBm".

(3) Connect the test leads to the circuit to be measured.

2—4—10 3 ½ Digit Display

When this switch is pressed, the least significant digit is blanked. Press again, and the five-digit display indication will be restored.

2—4—11 Data Hold

When this switch is pressed, the measured value is frozen on the display. Even when the test leads are separated from the measurement points, the display remains the same value.

For re-measurement, press the key again to cancel the hold condition. Using the touch hold probe(option), easy one-hand operation is possible.

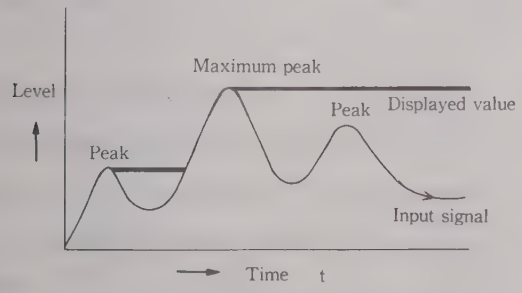
2—4—12 Peak Hold

This measurement function is used to measure the peak value of a signal.

It is usable with DC voltage/current, AC voltage/current and temperature measurement(in the manual-ranging mode).

To use this function, select the function and range and press the peak hold switch. When this is done, the "PEAK-H" will appear in the display. Next, by inputting a signal, the peak hold function operates. This peak hold value is held in digital memory for a long period.

To cancel the function, press the peak hold switch once again or press any other function switch or range switch.

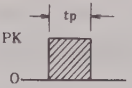
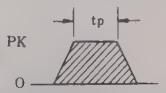


● The level in the above figure indicates the value of voltage, current or temperature.

Since the measurement error is determined by the peak hold detection circuit response time, examples of values for actual waveforms are given in the next section. Since the temperature measurement peak hold circuit operates digitally and since the temperature sensor response time is slow, there is inherently no measurement error.

(Example 1)

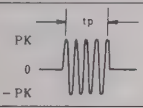
Errors encountered in measurement of instantaneous waveform peak values(DC voltage/current function).

Waveform	Measurement error with respect to peak value(%)	
	2% or less	5% or less
Squarewave 	tp>5ms	tp>2ms
Sinewave	t>10ms	t>5ms
Triangle wave	t>50ms	t>25ms
Trapezoid wave 	tp>5ms	tp>2ms

To measure negative signal peaks, reverse the connection of the test leads.

(Example 2)

Errors in measuring peak values after rms detection(AC voltage/current function)

Waveform	Measurement error with respect to peak value(%)	
	2% or less	5% or less
Tone burst 	tp>250ms	tp>150ms

For other types of waveforms, measurement is possible as long as the time at the peak value(tp) is within the above limits.

2—4—13 Relative Readings

In manual-ranging mode, if the "REL" switch is pressed, the input applied at that time is stored as a zero reference point, and the deviations from the reference point are displayed for subsequent measurements.

Caution: If the REL switch is pressed while the "OL" mark was indicated, the "REL" mark will be indicated on the LCD, although this function will not operate correctly.

If DC 10V is applied for measurement of DC voltage, 10.000V is indicated as shown in Fig. 2—5(a).

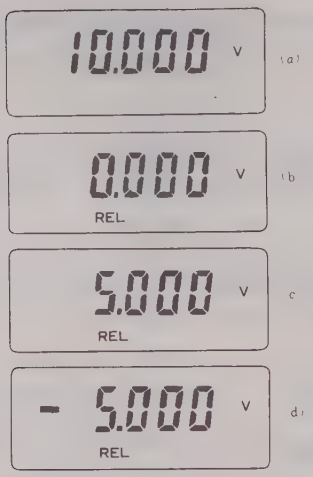


Fig.2 5

Press"REL" switch under this condition and the "REL" mark will be displayed, with the indication of 0.000V as shown in Fig.2−5(b).

Then, apply DC 15V and the deviation(5.000V) with respect to 10V is displayed Fig. 2−5(c).

Then,apply DC 5V, and −5.000 is displayed Fig. 2−5(d).

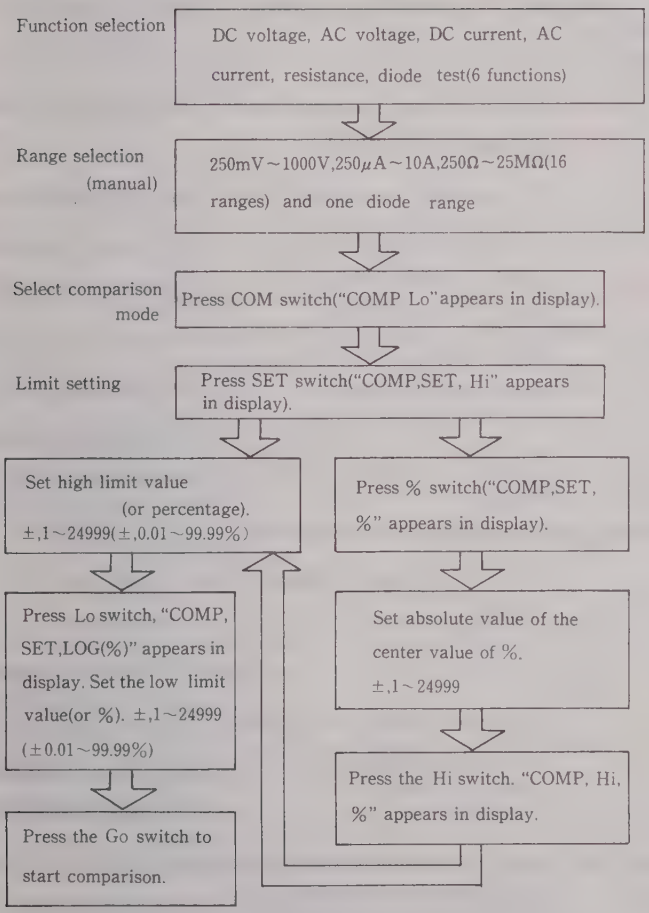
2—4—14 Comparator

This function is used to compare the measured value to preset upper and lower limit values.

The result of this comparison is displayed as "Lo", "Go" or "Hi". For the "Go"(i.e., botween limits) result, a beeper is sounded. A relay contact signal is also output at a connector.

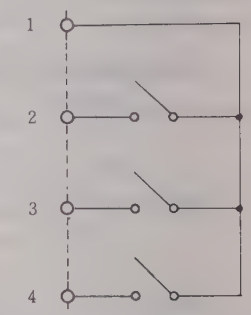
CAUTION

When the displayed value is "Lo", comparison is not made, so that the "Lo", "Go" and "Hi" displays as well as the relay contact signal do not occur.


Function selection
DC voltage, AC voltage, DC current, AC current, resistance, diode test(6 functions)
Range selection (manual)
250mV～1000V,250μA～10A,250Ω～25MΩ(16 ranges) and one diode range
Select comparison mode
Press COM switch("COMP Lo"appears in display).
Limit setting
Press SET switch("COMP,SET, Hi" appears in display).
Set high limit value (or percentage). ±,1～24999(±,0.01～99.99%)
Press % switch("COMP,SET, %" appears in display).
Press Lo switch, "COMP, SET,LOG(%)" appears in display. Set the low limit value(or %). ±,1～24999 (±0.01～99.99%)
Set absolute value of the center value of %. ±,1～24999
Press the Hi switch. "COMP, Hi, %" appears in display.
Press the Go switch to start comparison.

2—4—15 Rear Panel Output(EXT)

The output signal pin assignments for the DIN connector on the rear panel are as follows.

Connector pin number	Signal function	Remarks
1	"COM" relay contact for comparison results	
2	"Lo" relay contact for comparison results	
3	"Go" relay contact for comparison results	
4	"Hi" relay contact for comparison results	
5	"COM" power supply output	An external power output is available at these pins. This is linked to the 4800's power switch.
6	"+B" power supply output	
7	Signal common for AC voltage and current analog output.	A DC signal output in the range 0～+250.000mV is avilable and corresponds to the AC voltage and current rms detected value.
8	Analog signal output for AC voltage and current.	

2 — 5 Rms Values

● True RMS Measurement

When measuring AC signals, undistorted sinewaves are rarely encountered. For example, commonly encountered waveforms include squarewaves, triangle waves and sawtooth waveforms, in addition to the irregular noise signals encountered in communications and audio, thyristor chopped waveforms, logic signals and power consumption waveforms for such devices as home appliances. With previously available average-value detection, however, the measurement of these waveforms was accompanied by a large error(refer to Table 2—1). Essentially, this method is suitable for measurement of only low-distortion sinewaves, since it consists of average detection of the sinewave signal, after which the average value is multiplied by 1.11 to create an rms displayed value(hence the term average-detection rms indicating).

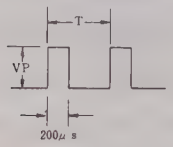
Thus, non-sinewave signals and irregular signals require measurement by a technique which derives the true rms value without regard to the waveform.

● AC Measurement Accuracy and Crest Factor

The crest factor of a signal is an important parameter in determining AC measurement accuracy, and is defined as the ratio of the signal peak value to its rms value. Commonly encountered signals such as sinewaves and triangle waves have low crest factor values(<2), while such signals as switching power supply current and noise signal waveforms have high(>2) crest factors. The point

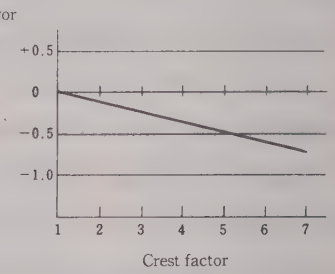
to remember is that the CF(crest factor) = peak value/rms value.

The 4800 uses a pulsewidth of 200μs to measure the crest factor and with a constant input rms voltage, the duty cycle and peak width are varied to perform measurements.



$$D(\text{Duty cycle}) = \frac{200\mu s \text{ (pulse width)}}{T \text{ (period)}}$$

$$CF = 1/\sqrt{D}$$



Relationship of Other Waveforms to a Sinewave ※4800

Input waveform	Displayed value			0~Peak	Crest factor
	True rms value (AC + DC)	※ True rms value (AC)	Average value defection /rms value calibration		
Sinwave	1.000	1.000	1.000	1.414	1.414
Triangle wave	1.000	1.000	0.960	1.732	1.732
Square wave	1.000	1.000	1.110	1.000	1.000
Full-wave rectified	1.000	0.435	0.421	1.414	1.414
Half-wave rectified sine	1.000	0.771	0.764	2.000	2.000
Pulse (50%duty)	1.000	0.707	0.785	1.414	1.414
Pulse D=a/b	1.000	$\frac{\sqrt{D-D^2}}{\sqrt{D}}$	$\frac{1.11\sqrt{D-D^2}}{\sqrt{D}}$	$\frac{1}{\sqrt{D}}$	$\frac{1}{\sqrt{D}}$

3. OPERATING PRINCIPLE

3 — 1 Outline

Fig. 3—1 shows the block diagram of the Model 4800, which consists of the following circuits.

- Voltage attenuator circuit
- Reference resistance
- Current shunt resistance circuit
- AC rms value detection circuit
- Peak hold circuit
- Reference junction compensation circuit
- Reference voltage supply
- Beeper circuit
- Frequency counter circuit
- Comparator output circuit
- Function/range switch circuit
- Memory backup power supply
- A-D Conversion section
- A-D Control microcomputer
- LCD and driver circuit
- Regulated power supply circuit

3 — 2 Block Diagram Description

The following is a description of the various parts shown in the block diagram.

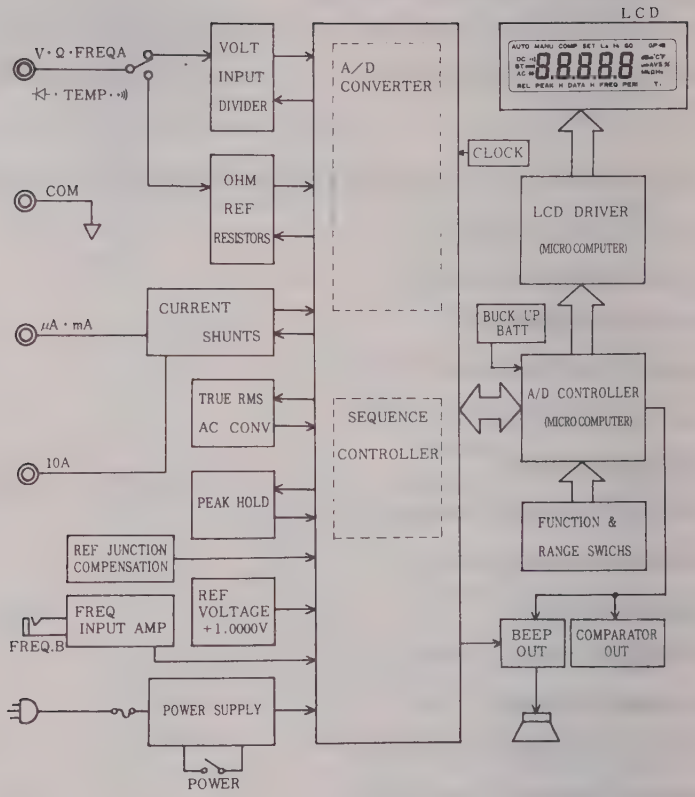
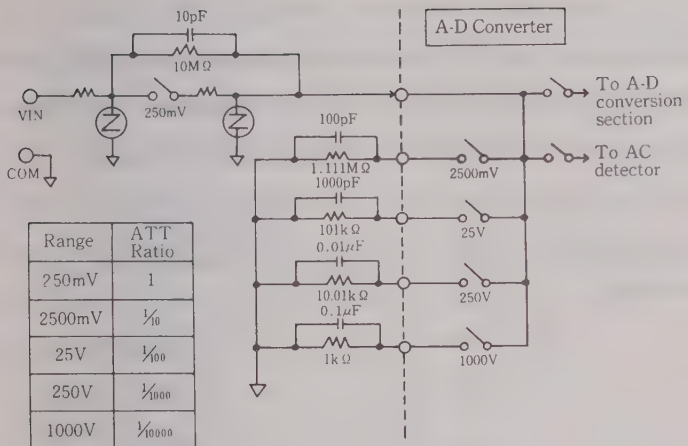


Fig. 3—1 4800 Block diagram

3—2—1 Voltage Attenuator Circuit(Input Voltage Divider)

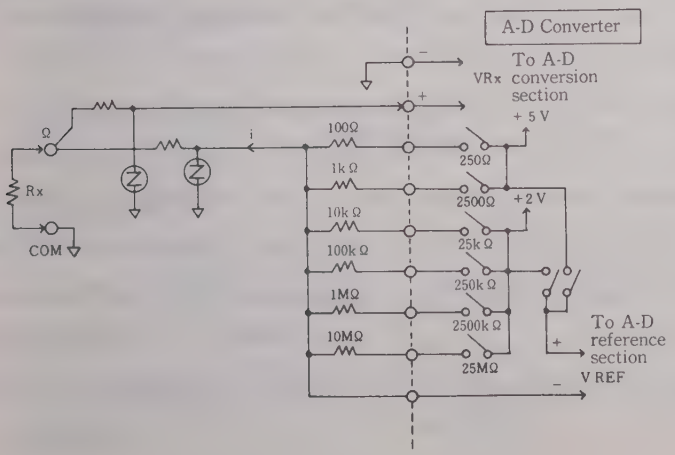
After passing through an over-voltage protection circuit, an input signal voltage is supplied to an A-D converted and attenuated, depending upon the voltage level.



Range	ATT Ratio
250mV	1
2500mV	1/10
25V	1/100
250V	1/1000
1000V	1/10000

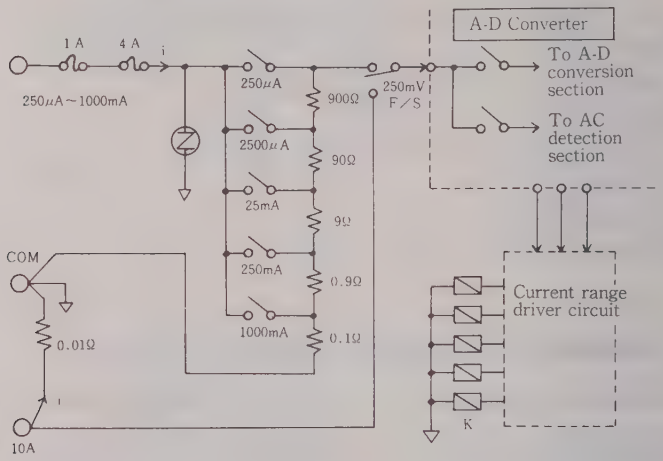
3—2—2 Reference Resistance(Ohm Reference Resistors)

For resistance measurement, a current is driven through the resistance to be measured and a comparison is made between the voltage across the resistance being measured and that across a reference resistance.



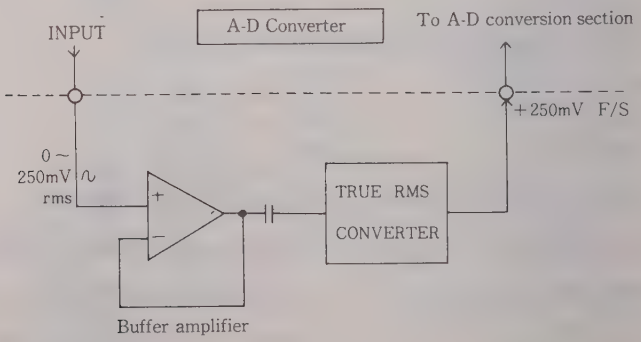
3—2—3 Current shunt Resistor Circuit

After passing through an over-current protection circuit, a current input signal is applied to an A-D converter and to a selected shunt resistance, depending upon the current signal amplitude.



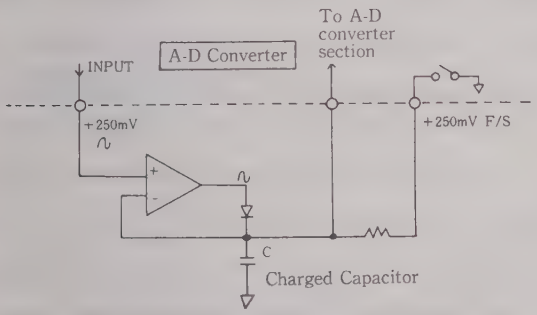
3—2—4 True RMS AC Converter

AC signals are true rms converted to enable conversion to a DC voltage.



3—2—5 Peak Hold Circuit

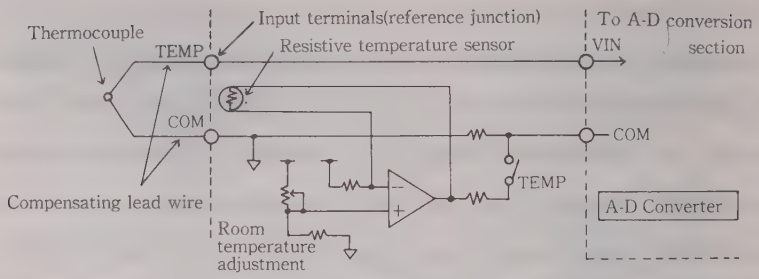
DC signals or AC signals which have been converted to DC signals are peak hold detected and the peak voltage value stored by a capacitor in this circuit. After this process, the voltage is A-D converted for display. After this conversion and display is made, unless the measured signal exceeds the currently displayed value, the display is held. Reset is performed by means of an analog switch through which the capacitor is discharged.



3—2—6 Reference Junction Compensation Circuit

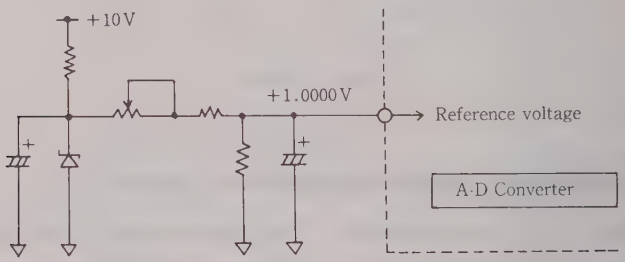
For temperature measurements, the thermocouple electromotive force depends upon the temperature difference between the measured point and the reference junction. In the 4800, the reference junction temperature is measured using a resistive temperature measuring element and a voltage corresponding to this temperature is added to compensate this thermoelectric voltage, enabling compensation for the reference junction.

The thermocouple characteristics are linearized by using a microcomputer.



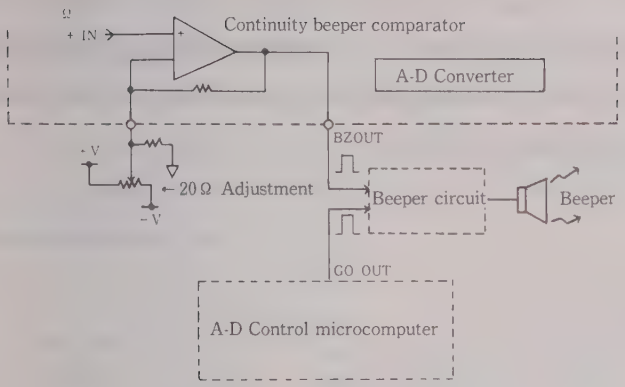
3—2—7 Reference Voltage Supply

When measuring voltage or current, a temperature compensated supply of 1.0000V is required for use as the A-D converter reference voltage. In the 4800, a temperature-compensated zener diode is used in this circuit.



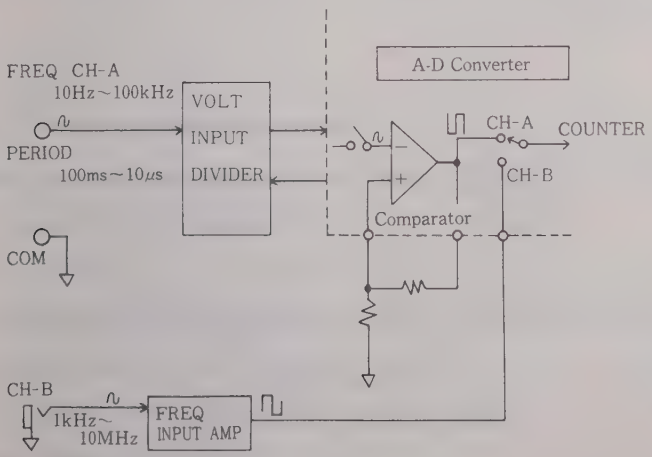
3—2—8 Beeper Circuit

A beeper sounds for resistances 20Ω or less during continuity checks and when the comparison results are "Go". When making continuity checks, an analog comparator is used to determine when the resistance is 20Ω or less. At the comparator, the microcomputer Go signal is output.



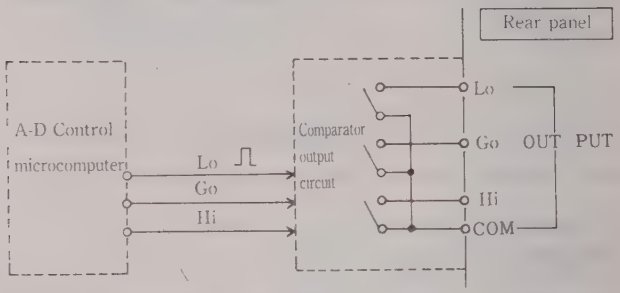
3—2—9 Frequency Counter Circuit

Two channels(CH-A and CH-B) are provided for frequency measurement, the measurement method differing for these two channels. At CH-A, the period of the input signal is measured and a microcomputer is used to convert this to the corresponding frequency. CH-B directly counts pulses during a fixed time period.



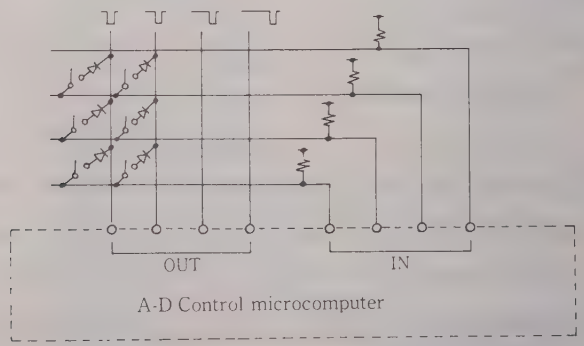
3—2—10 Comparator Output Circuit

In addition to providing a "Go" LCD indication and sounding a beeper, this circuit controls relay outputs for the "Lo", "Go" and "Hi" comparator result conditions.



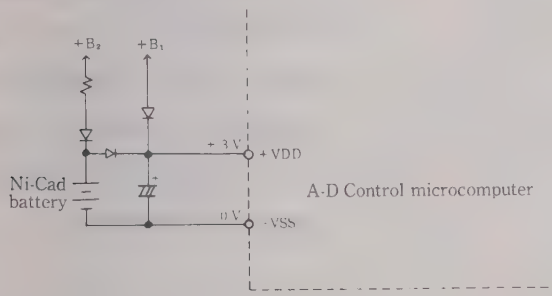
3—2—11 Function and Range Switching Circuit

All functions and ranges are selected by means of touch switches. Operation of these switches is detected by means of a microcomputer controlled diode matrix.



3—2—12 Memory Backup Battery

The high and low limit values set for comparator operation must be held even when the power is switched off. In the 4800, when the power switch is OFF or a power failure occurs, a Ni-Cad battery is selected automatically by the microcomputer to hold such data as function, range and comparison limits.



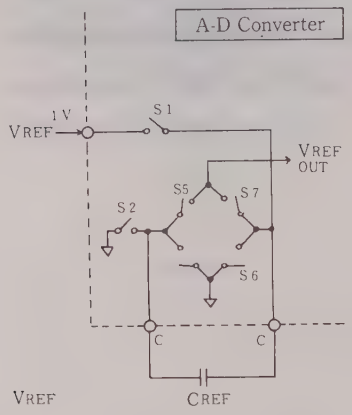
3—2—13 A-D Conversion Section

The A-D conversion section may be divided into the V_{REF} circuit and a dual integration A-D converter.

(a) V_{REF} Circuit

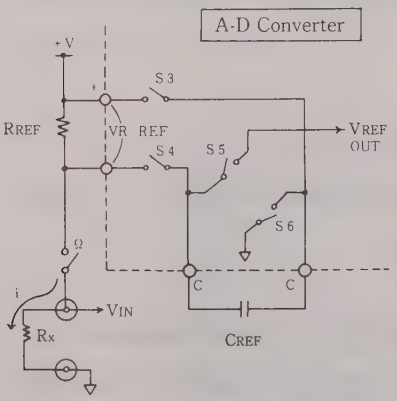
In this circuit, for voltage measurement, a reference capacitor C_{REF} is charged up to the reference voltage V_{REF}. For resistance measurement, it is charged up to the voltage drop across the reference resistance VR_{REF}.

Voltage Measurement Configuration



- During the input signal integration period(IN INTEG), S_1 and S_2 are ON and C_{REF} charges up to V_{REF}.
- During the reference signal integration period(REF INTEG), S_5 and S_6 are ON and the charged voltage($V_{REF\ OUT}$) across C_{REF} is output. If the voltage input being measured is negative, S_7 and S_8 are ON and the polarity of $V_{REF\ OUT}$ is reversed.

Resistance Measurement Configuration



- During the input integration period(IN INTEG), S_3 and S_4 are ON and C_{REF} charges to the R_{REF} voltage drop.
- During the reference signal integration period(REF INTEG), S_5 and S_6 are ON and the charged voltage($V_{REF\ OUT}$) across C_{REF} is output.

(b) Dual-Slope Integration Type A-D Converter

The circuit cofiguration of this A-D converter is shown below.

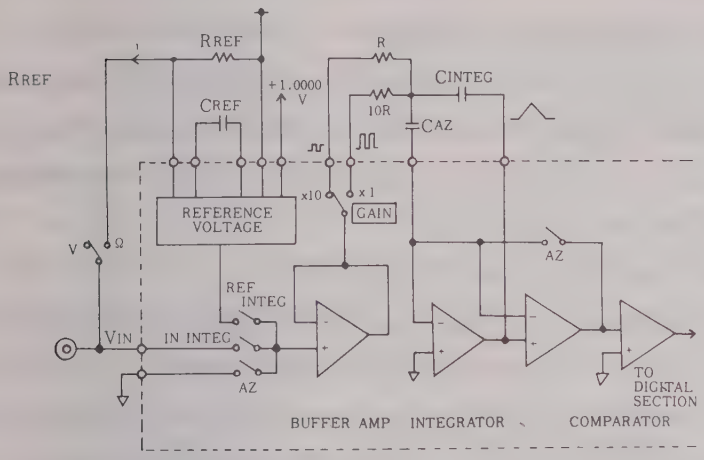


Fig. 3—2 A-D Converter analog section

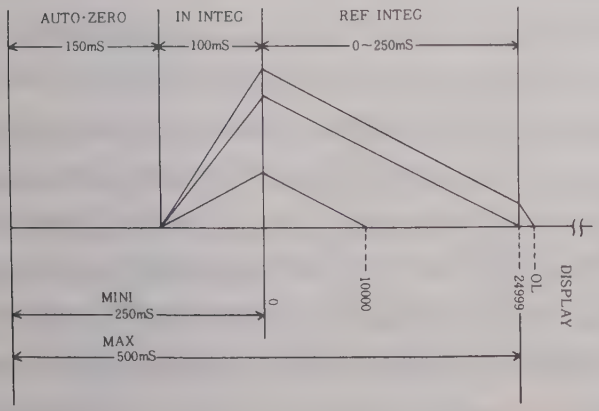


Fig. 3—3 A-D Converter measurement cycle

In Fig. 3 3, the measurement cycle can be broken up into the auto -zero, input signal integration and reference signal integration periods.

● Auto-Zero Period(AUTO ZERO)

At first, the buffer amplifier input is shorted to the analog common, closing this loop and enabling the buffer amplifier, integrator and comparator offsets to be established, thus charging the auto-zero capacitor C_{AZ}.

● Input Signal Integration Period(IN INTEG)

When the auto-zero loop opens, the input short is removed and the input signal is connected to the buffer amplifier. For voltage measurement and resistance measurement in the 250Ω range, the integrator gain is set to ×10 and, for resistance measurements in the 2500Ω range and above, it is set to ×1. Integration over a fixed period of time is performed using the time constants of R and C_{INTEG} or 10R and C_{INTEG} respectively.

The reference capacitor C_{REF} is charged to the reference voltage.

● Reference Signal Integration Period(REF INTEG)

This period is also known as the reverse integration, during which integration of the reference voltage V_{REF} having a reverse polarity of the input signal is performed. During this integration period, the integrator gain is set to ×1 and integration is performed until the integrator output reaches zero, this period of time being measured and displayed. In the 4800, this time period length(i. e., input signal amplitude) is used to continuously vary the cycle(sampling speed) over the range 250ms~500ms(4 times per second to 2 times per

second).

3—2—14 A-D Control Microcomputer

This microcomputer performs all control functions, which consist basically of the following.

(a) Reading of the function and range switch settings and issuance of commands to the A-D converter.

(b) Transfer of data from the A-D converter to the LCD microcomputer.

(c) Frequency-period conversion

$f=\frac{1}{T}$ f : Frequency, T : Period

(d) Relative Calaulation

(Displayed measured value) = (Actual value) − (Initial value)

(e) dBm Conversion

For AC voltage measurements, a constant logarithmic approximation calculation is performed to convert the measured values to dBm(decibel).

(f) Temperature Measurement Compensation

For temperature measurement, a piecewise linear compensation of thermocouple characteristics is performed.

(g) Comparator Function

For comparator operation, comparison is made of the amplitude of measured values with respect to the set upper and lower limits.

For percentage setting, the following calculation is performed for the comparison.

$$[\text{Measured value } \%] = \left(\frac{\text{measured value}}{\text{center value}} - 1\right) \times 100$$

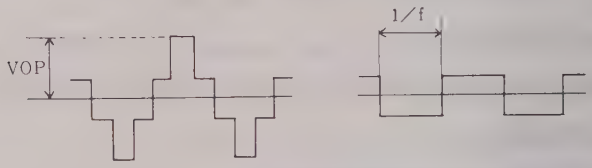
(h) Data Memory Hold Function

A memory backup battery is used to hold data when the power is switched off.

3—2—15 LCD and LCD Driver

This consists of a microcomputer which drives the LCD to indicate data from the A-D control microcomputer and the liquid crystal display itself.

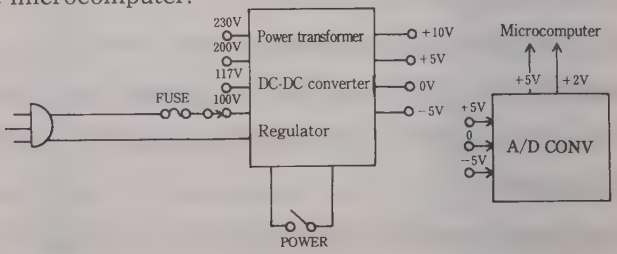
The LCD is driven using a ⅓ duty cycle, ⅓ bias voltage-constant technique, with typical drive waveforms shown below,



[Selected waveform] [Non-selected waveform]

3—2—16 Regulated Power Supply

The power supply consists of a power transformer and DC-DC converter which provides three power supplies, consisting of ±5V and +10V. In addition, +2V is generated within the A-D converter to operate the microcomputer.



4. OPTIONAL ACCESSORIES

Optional accessories are shown in the following table.

No.	Name	Model number	Remarks
1	Touch hold probe	TP—10	Usable to freeze the data value on the display.
2	10A Measurement cable	TL—8	Terminated in banana plugs and alligator clips.
3	Temperature probe(with protective sheath)	TX—502	−50℃~200℃ JIS 04 Class K(CA) type Thermocouple
4	Temperature probe(with protective sheath)	TX—507	−50℃~700℃ JIS 04 Class K(CA) type Thermocouple
5	Temperature probe(surface type)	TX—506	−50℃~600℃ JIS 04 Class K(CA) type Thermocouple

5. MAINTENANCE

Should trouble be suspected in operating the 4800, before requesting service, make the following checks. Should doubt still remain after these checks, consult your local sales or service representative.

Trouble	Cause of trouble	Solution
No indication on LCD or no beeper operation when power is switched ON.	Microcomputer misoperation due to externally introduced noise.	Cancel the key lock switch and press the RESET switch on the panel.
Frequent occurrence of no indication on LCD or no beeper operation	Long periods of use have caused discharge of the backup battery.	Perform the operation described above. To allow charging of the backup battery, leave the unit powered ON for several days.
Current measurement impossible(1A or less).	Over-current protective fuse has blown.	Replace the 1A over current fuse described in this manual. If, after replacing this fuse, operation is still not possible, the 4A/600V fuse within the

		unit may have blown as well. If so, consult your sales/service representative.
Frequency(period) measurement impossible.	Improper CH-A and CH-B frequency measurement terminals. Improper selection of CH-A and CH-B. Improper setting of input voltage attenuator(CH-A only).	Refer to sections 2.4.6 and 2.4.7 and recheck.

When making requests for repair service, please bring the instrument directly to the dealer. If this is impossible, however, send the instrument directly to our sales office.

When mailing this instrument, always pack it in its original or equivalent packing material and pack together with name, address, telephone number and the warranty documentation.

- To ensure speedy and reliable repair, always include information as to the type of failure and cause.
- If required, always return accessories with the instrument.
- When contacting us, provide the model number and serial number of your instrument.

6. LIMITED WARRANTY

The Triplett Corporation warrants instruments and test equipment manufactured by it to be free from defective material or factory workmanship and agrees to repair or replace such products which, under normal use and service, disclose the defect to be the fault of our manufacturing, with no charge for parts and service. If we are unable to repair or replace the product, we will make a refund of the purchase price. Consult the Instruction Manual for instructions regarding the proper use and servicing of instruments and test equipment. Our obligation under this warranty is limited to repairing, replacing or making refund on any instrument or test equipment which proves to be defective within one year from the date of the original purchase.

This warranty does not apply to any of our products which have been repaired or altered by unauthorized persons in any way so as, in our sole judgment, to injure their stability or reliability, or which have been subject to misuse, abuse, misapplication, negligence or accident or which have had the serial numbers altered, defaced, or removed. Accessories, including batteries, not of our manufacture used with this product are not covered by this warranty.

To register a claim under the provisions of this warranty, return the instrument or test equipment to Triplett Corporation, Bluffton, Ohio 45817, transportation prepaid. Upon our inspection of the product, we will advise you as to the disposition of your claim.

ALL WARRANTIES IMPLIED BY LAW ARE HEREBY LIMITED

TO A PERIOD OF ONE YEAR, AND THE PROVISIONS OF THE WARRANTY ARE EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES EXPRESSED OR IMPLIED.

The purchaser agrees to assume all liability for any damages and bodily injury which may result from the use or misuse of the product by the purchaser, his employees, or others, and the remedies provided for in this warranty are expressly in lieu of any other liability Triplett Corporation may have, including incidental or consequential damages.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

No representative of Triplett Corporation or any other person is authorized to extend the liability of Triplett Corporation in connection with the sale of its products beyond the terms hereof.

Triplett Corporation reserves the right to discontinue models at any time, or change specifications, price or design, without notice and without incurring any obligation.

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